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COMPARISON OF DISSOLVED ORGANIC CARBON CONCENTRATIONS AND COMPOSITION, AND TRIHALOMETHANE FORMATION POTENTIALS IN WATERS FROM THREE WETLAND HABITAT TEST PONDS

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Water exported from the Sacramento-San Joaquin River delta (Delta) supplies drinking water to more than 22 million people in California. Delta waters contain elevated concentrations of dissolved organic carbon (DOC) and bromide (Br) and can, at times, exceed the U.S. Environmental Protection Agency's maximum contaminant level for trihalomethanes (THMs) of 0.100 mg/L (U.S. Environmental Protection Agency, 1994) if chlorinated for drinking water. Drainage water from Delta islands is estimated to provide about 20 to 50% of the DOC that contributes to the formation of THMs in water exported from the area for drinking water. The primary source of DOC and THM precursors is believed to be the peat soils that cover most of the islands in the Delta.

Considerable effort is currently focused on restoring wetland habitat and mitigating subsidence in the Delta. One important consideration that has not yet been addressed is how these restoration and mitigation efforts affect the quality of drainage water. In particular, what concentrations and quality (THM precursors) of DOC result from converting Delta peat soils from agricultural use to wetland habitat. This study investigated the effects of the three wetland-habitat treatments on water quality, in particular DOC and THM precursor concentrations released from the soils in controlled test ponds in the Delta on Twitchell Island, California.

Two of the three wetland-habitat test ponds consisted of 85-m^2 enclosures, and the third test pond was a small (about 55 m^2) spring-fed pond (Open-Water Pond). One of the enclosed ponds is continuously flooded (Continuously Flooded) to a depth of about 30 to 45 cm. This flooded pond has been in operation since 1993, and an abundance of cattails (*typha*, spp.) cover the pond. The other enclosed pond is a reverse-flooding treatment pond (Reverse Flooded) that is intentionally flooded to a depth of about 30 cm from early spring through the end of July. Winter precipitation keeps this pond moist to very wet (standing water) during late December through February. Stainless steel piezometers were installed in each test pond to sample water from 15 to 45 cm below land surface. Water samples were collected approximately monthly from March 1996 through January 1997, except in the Reverse Flooded pond, which was too dry to obtain samples during parts of this period. Samples were analyzed for DOC, ultraviolet absorbance at 254 nm (UVA), and trihalomethane formation potential (THMFP) using a dose-based method developed by the California Department of Water Resources (1994).

DOC released from the soil indicates three distinct populations for the three treatments (fig. 1). In general, concentrations of DOC were (in decreasing order): Reverse Flooded, Continuously Flooded, Open-Water Pond. The highest DOC concentrations were in the summer months. Even though DOC concentrations were distinctly different for the three

treatments and covered a wide range (5.8-208 mg/L), DOC aromaticity [as indicated by specific UVA (SUVA, UVA/DOC)] for all samples was high and fairly similar (median SUVA values of 0.077, 0.074, and 0.066 L/mg-cm for the Open-Water Pond, Continuously Flooded, and Reverse Flooded treatments, respectively) (fig. 2). For comparison, three San Joaquin River samples taken in October 1997 had DOC concentrations that range from 2.5 to 4.7 mg/L and SUVA values ranging from 0.011 to 0.022 (L/mg-cm); and peat soil water sampled from 15 to 45 cm below land surface from an agricultural field on Twitchell Island in 1996 had DOC concentrations ranging from 13.1 to 139 mg/L and SUVA values ranging from 0.029 to 0.048 L/mg-cm (Fujii et al., 1998).

THM precursor concentrations, as indicated by THMFP measurements, follow trends, in decreasing order, similar to those found for DOC: Reverse Flooded, Continuously Flooded, Open-Water Pond. Concentrations of THMFP ranged from 5,320 to 24,430 µg/L for the Reverse Flooded treatment, from 1,730 to 12,890 µg/L for the Continuously Flooded treatment, and from 619 to 1,669 µg/L for the Open-Water Pond treatment. The molar reactivity of the carbon to form THMs is indicated by specific THMFP (STHMFP, THMFP/DOC) on a molar basis. The quality of carbon found in these wetland-habitat test ponds is extremely reactive with STHMFP values ranging from 8.1 to 16.1 µ*M*/m*M* (fig. 3). In general, the molar reactivity of carbon to form THMs is greatest for the Open-Water Pond during the summer months when duck weed is growing profusely in the pond. For comparison, STHMFP values for the agricultural field (Fujii et al., 1998) ranged from 7.2 to 11.2 µ*M*/m*M*, and one San Joaquin River sample had a value of 4.7 µ*M*/m*M*. In addition, a poor correlation (R^2=0.20) between STHMFP and SUVA was found, indicating that carbon aromaticity is not a good predictor of THM precursors for these samples.

These data demonstrate that the soil water associated with the three different wetland habitats investigated produce high concentrations of DOC that are very aromatic and have a high propensity to form THMs. Although this study did not measure drainage associated with the test ponds and, therefore, did not quantify the loads of DOC and THM precursors, these results emphasize the need to consider effects on water quality for various wetland habitat restoration and subsidence mitigation measures being considered in the Delta.

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References Cited:

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U.S. Environmental Protection Agency, 1994, Drinking water regulations and health advirories, 822-R-94-001, 10 p.

Figure Captions:

Figure 1. Dissolved organic carbon (DOC) concentrations for three wetland habitat test ponds, March 1996-January 1997, Twitchell Island, California.

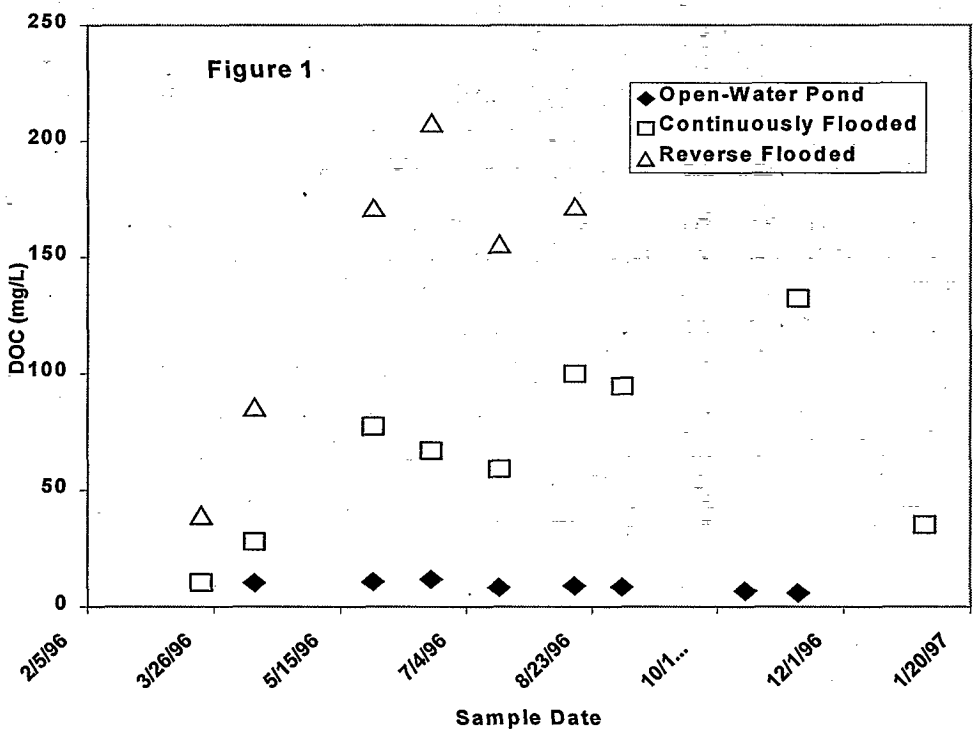


Figure 2. Specific ultaviolet absorbance (SUVA) measurements for three wetland habitat test ponds, March 1996-January 1997, Twitchell Island, California.

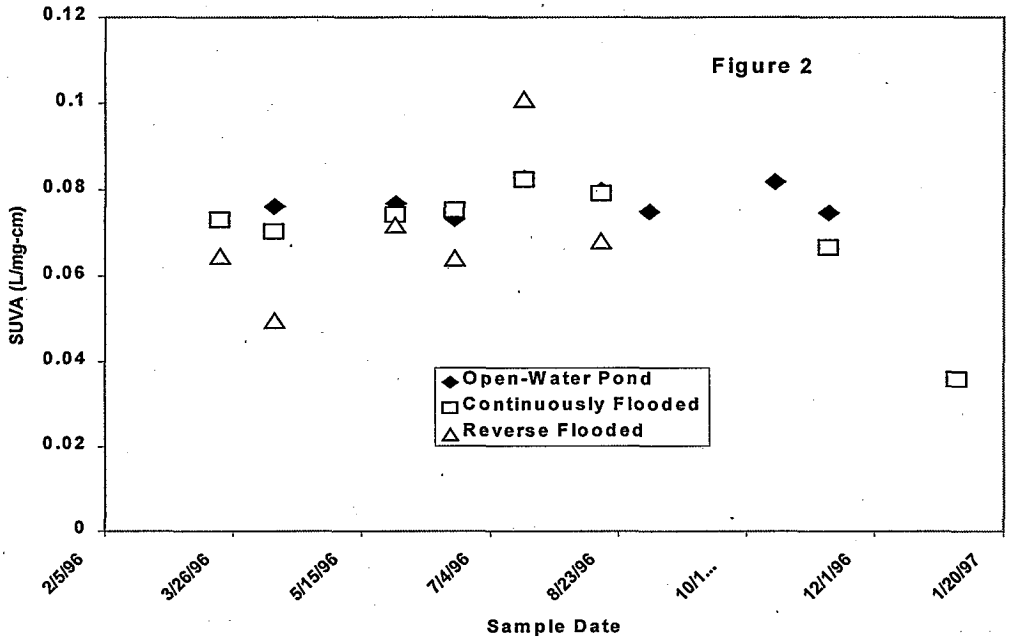
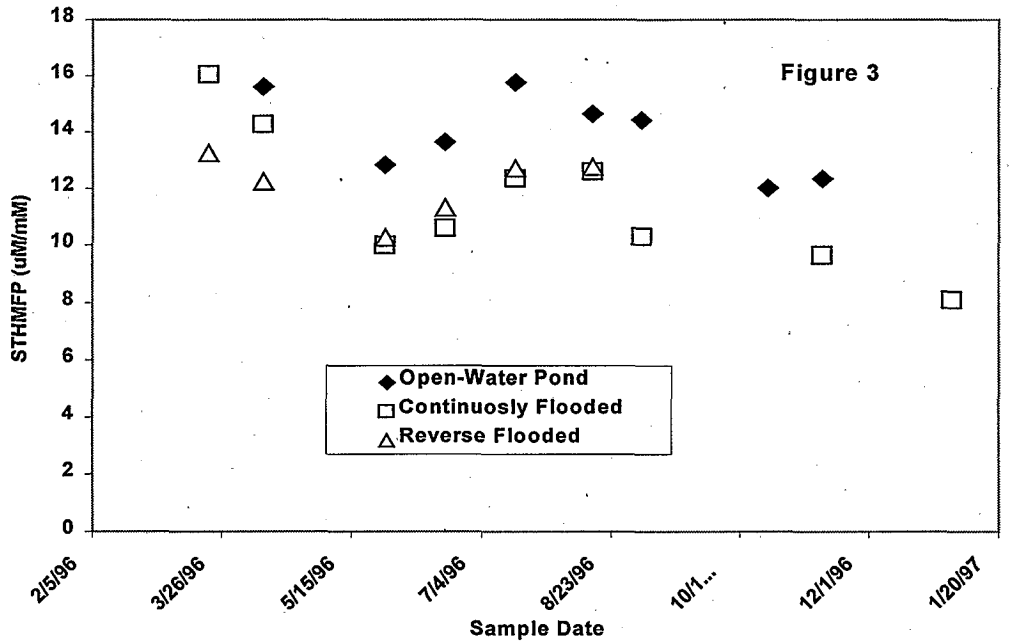


Figure 3. Specific trihalomethane formation potential (STHMFP) measurements for three wetland habitat test ponds, March 1996-January 1997, Twitchell Island, California



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